Math 418/544 Probability I Fall 2018

Instructor: Ed Perkins, Math Annex 1207
Contact: perkins@math.ubc.ca
Lectures: MWF 10:00-10:50 in Math 203.
Course webpage: `http://www.math.ubc.ca/~perkins/teaching.html`
Office hours: TBA
Text: R. Durrett. *Probability: Theory and Examples.* Version 5.a available for free download at the author's webpage at
`https://services.math.duke.edu/~rtd/PTE/pte5.html`
If you have any trouble downloading it, a copy will eventually be on the course webpage.

Course outline:

Together with Math 419/545 in term 2, these courses give a comprehensive introduction to mathematically rigorous and measure-theoretic probability theory for honours undergraduates and graduate students. Math 418/544 will "follow" (at times we will depart from the text presentation) the first 3 Chapters of the above text, and some of Chapter 4:

1. Foundations. [Ch. 1] Probability spaces, random variables, expectation, some results from measure theory.

2. Laws of Large Numbers. [Ch. 2] Independence, modes of convergence, Borel-Cantelli Lemma, Kolmogorov Extension Theorem (statement only), weak and strong laws of large numbers, Kolmogorov 0-1 Law, introduction to random walk.

3. Central Limit Theorem. [Ch. 3] Weak convergence, characteristic functions, Binomial convergence to the Poisson law, central limit theorem, multidimensional central limit theorem.

4. Conditional Expectation and Introduction to Martingales. [Sec. 4.1, 4.2, ??] Conditional expectation, martingales and submartingales, martingale convergence theorem.

The course is intended to be useful for those who use probability as a tool in other fields, or planning to do research in probability. Probability theory has applications in analysis, electrical and computer engineering, statistics,

economics, finance, applied mathematics, math biology, combinatorics and partial differential equations and has ties to many other fields. Students interested in these fields are encouraged to enrol.

Prerequisite: 68% in Math 321 (or equivalent) or consent of the instructor. Background in measure theory (e.g. math 420) is not strictly required, and the requisite notions will be introduced in class. Some results from measure theory will be stated without proofs. It is often rewarding to take a measure theory course at the same time although it is not a corequisite either.

Further Reading. Here are a few textbooks that cover much of the course material:

Probability

L. Breiman. *Probability.*
R. Ash. *Real Analysis and Probability*
D. Williams. *Probability with Martingales.*
P. Billingsley. *Probability and Measure.*
O. Kallenberg. *Foundations of Modern Probability.*
A. Klenke. *Probability Theory: A Comprehensive Course.*

Measure Theory

R. Ash. *Real Analysis and Probability (or Real Analysis)*
H. Royden *Real Analysis*
W. Rudin *Real and Complex Analysis*

Evaluation:

Homework will be assigned regularly (5 or 6 in total) for 60% of the grade. Late submissions will not be accepted.

There will be a 2 hour midterm 5:30-7:30, Thurs. November 15 for 40% of the grade.